U. S. DEPARTMENT OF AGRICULTURE

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THE PRODUCTION OF PEAS FOR CANNING

PEAS rank third in tonnage among the canned vegetables of this country. Their production is centralized for the most part in the region about the Great Lakes.

Because of their leguminous nature, canning peas fit admirably into a general farm rotation and have a marked influence in increasing the yield of crops which follow them. They may be used as a nurse crop for alfalfa and other stock-feeding plants or they can be followed during the same year with another crop.

The pea crop requires a mellow, fertile, well-drained soil. The seed bed should be deeply prepared and left with a smooth surface to facilitate harvesting with a mower. The crop, as usually grown in drills like wheat, requires no cultural attention after the seed is sown.

Peas for canning pass their prime condition within a very few days. The crop must be handled promptly and the peas canned with dispatch to produce a product of high quality.

The utilization of pea-vine refuse as feed is an important asset in dairy and stock-feeding regions.

The growing of canning peas is a specialized industry and requires the closest cooperation between the grower and the canner.

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THE PRODUCTION OF PEAS FOR CANNING.

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CONTENTS.

IMPORTANCE OF THE PEA-CANNING INDUSTRY.

PEAS occupy third place among the canned-vegetable commodities of this country, being exceeded in tonnage only by tomatoes and sweet corn. The industry began about the middle of the last century in the region around Baltimore, Md., and its growth has been gradual until now it is looked upon as an important enterprise in the States where peas are grown and canned. The canned product put up in a well-managed factory is sanitary and often comes to the table in better condition than many of the green peas displayed for sale in the markets. It is, moreover, compact and economical, as a single No. 2 can holds a sufficient quantity to provide liberal portions for a family of five. The acreage, yield, and value for the United States during the 3-year period from 1924 to 1926, inclusive, were approximately as shown in Table 1.

TABLE 1.—*Acreage, yield, and value of peas for canning in the United States for the 3-year period 1924–1926*

[Data from "Weather, Crops, and Markets," summary, December, 1926]

Items of comparison.	1924	1925	1926
Acreage	226,590	226,630	218,400
Production in tons	244,000	206,300	214,400
Value	$14,493,000	$12,077,000	$12,420,000

DISTRIBUTION OF THE PEA-GROWING INDUSTRY FOR CANNING.

The growing of peas for canning purposes was at one time restricted to the Middle Atlantic States. In some sections of these States this industry is still one of primary importance. It is now centralized for the most part in the region about the Great Lakes. Wisconsin leads in the canning of peas, while New York ranks second, with an average pack of about two-thirds that of Wisconsin. These two States furnish about 60 per cent of the entire canned-pea output of the United States. (Fig. 1.) The industry is developed to a lesser degree in Michigan, Maryland, Indiana, Illinois, Utah, Delaware and New Jersey, Ohio, California, Colorado, Minnesota, Pennsylvania, and

FIG. 1.—A field containing more than 30 acres devoted to peas for canning.

Tennessee. The geographical distribution of the industry is indicated by the accompanying map. (Fig. 2.) Each dot designates the location of a factory in which peas are commercially canned.

Being essentially a cool-weather crop, peas will germinate and make a healthy and vigorous growth of vines at a lower temperature than most garden vegetables. The young plants will endure some frost without serious damage. The blossoms and young pods, however, will be injured or killed by a frost which would not materially check the growth of the plant itself. The crop is grown most successfully in those regions where spring is a little slow in changing from cool to warm weather. The period of harvest is too brief and the other hazards of the crop are too great for its successful production in parts of the country where conditions are not favorable.

Cool and moist weather is needed to perfect the growth of the plants. The slow growth of the crop will develop sweetness, flavor, and other attributes of quality in peas; retarded development will aid in the perfection of long pods and will permit the formation of a number of gradations in the size of the peas. These variations in size will allow the factory to prepare and market the several grades demanded by the trade. Warm weather, on the contrary, will throw the plants into flower before they have stored up the materials necessary for seed production. A shortened period of growth causes the plants to form short pods containing peas all of one size. If the weather becomes excessively hot, the growth of the vines may be

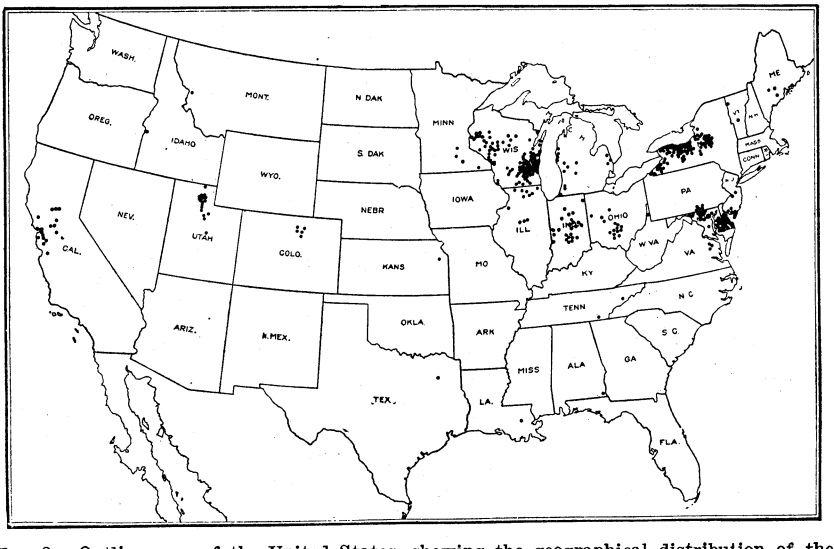

FIG. 2.—Outline map of the United States, showing the geographical distribution of the pea-canning industry in 1920. Each dot designates the location of a factory in which peas are commercially canned.

seriously affected, the yield reduced because of the limited number of pods set, and the peas be poor in quality. Under such conditions the entire pea crop is liable to mature rapidly, to the disadvantage of both the grower and the canner. Furthermore, hot weather increases the prevalence of pea diseases.

METHODS FOLLOWED BY CANNERS TO PROVIDE A SUPPLY OF PEAS.

The canning of peas is a specialized industry. For economic reasons several canning crops are usually grown in the same vicinity. The location of a canning factory is determined by the prospects of obtaining the various crops to be handled at equitable prices and in sufficiently large quantities to run the plant at its full capacity for a

reasonable length of time. It is essential that the crops be delivered to the cannery with little delay after harvesting, in order that canned products of high quality may be prepared. Therefore, the factory must be as near as possible to the production center of the commodities to be canned. Good roads are an asset for the hauling of the harvested crops. Factory labor is an important item, and usually the cannery is located near a small village.

The pea crop is usually grown under contract, the canning companies specifying the varieties and the acreage to be planted by each grower. In some localities the canners themselves own or lease land upon which they grow a portion of the requirements of their factory. Whatever method is employed in providing a supply of peas, the canners usually assume general direction of the crop, including the selection of the land. Many of the companies exercise the right to provide the seed. They handle these in order that the varieties planted shall be those which are best adapted to the demands of the trade. The canner grows or buys the seed and often sells it to the growers at a lower price than the original cost. An intelligent field man is an asset, for he comes in close contact with the growers, helping them to solve their problems and giving instructions as to the care and harvesting of the crop. The agent of the company examines the fields as the harvest period approaches. He directs that the peas be harvested and delivered at the most timely period, as judged by the maturity of the crop, the ability of the farmer to deliver, and the capacity of the cannery to handle the material. The acreage for the average grower is limited by the area of suitable soil under cultivation, the character of the equipment he possesses, especially for the harvesting of the crop, and the number of laborers available during the rush period. From 10 to 15 acres of peas will maintain a fair rotation balance for a farm of 100 acres. Some individual growers specialize on peas and grow a much larger acreage.

CROP ROTATIONS.

The canning pea is considered an important crop in those sections where it can be grown. The pea makes an ideal addition to a rotation, as it is a nitrogen-gathering crop, and land devoted to it, when properly handled, increases in productiveness. However, successive plantings of peas year after year usually cause "pea-sick" soils. This fact makes it desirable that the crop be included in a farming system that will not bring it on the same land oftener than once in every four or five years.

Many growers are of the opinion that peas do best when they follow some cultivated crop which has been well fertilized. As the crop makes most of its growth in early spring, it is probable that the

readily available plant food left over from the previous crop is a distinct help to the peas.

These rotations are suggested:

Four-year system.—(1) Sod crop; (2) corn or potatoes; (3) peas; (4) wheat, oats, or barley.

Five-year system.—(1) Mixed clover or alfalfa; (2) hay; (3) corn, potatoes, or cabbage; (4) peas; (5) wheat, oats, or barley.

Since the attacks of the pea louse are frequently destructive, precautionary measures should be taken. The pea aphis is carried over winter on the clovers. This pest subsists during the rest of the year on some varieties of clover, the various types of peas, the vetches, not infrequently on alfalfa, and doubtless on other similar crops. It would be advisable, therefore, either to arrange the rotation of the farm fields so that the pea land would not be in proximity to those crops or to harvest such crops early in the season.

COMPANION OR COMBINATION CROPS.

The growing of peas affords the opportunity for the sowing of other desirable crops, both being planted at the same time. Some farmers advocate the use of the pea as a nurse crop for alfalfa, in order to secure a profitable return while the alfalfa is developing. This is especially true in dairy sections, where the alfalfa will furnish material for feeding in the autumn or during the following year.

Alfalfa is sown for the most part with the early varieties of peas, like the Alaska, since this variety produces a small vine growth which does not smother the new seeding. Late varieties, such as the Admiral, are usually considered too heavy in vine growth, and, besides, they allow only a shortened period for development after the harvest of the peas. Silty soils are usually too dry for such combinations because of injury to the alfalfa by the mowing of the peas. Under favorable conditions the alfalfa is usually about a foot high when the peas are cut, and it immediately starts renewed growth. Clover is sometimes substituted for alfalfa, while grass seed has been sown with peas to provide fall pasturage.

CROPS TO FOLLOW PEAS IN THE SAME YEAR.

In many sections of the country where the early types of peas are harvested during the first part of June the land may be fitted immediately for another crop. Many growers disk the stubble on the day the pea crop is removed, in order to conserve the moisture in the soil. Along the southern border of successful canning-pea production such crops as silage corn, field corn, sweet corn, tomatoes, late potatoes, spinach, Lima beans, millet, or cowpeas are planted as soon as the land can be prepared after the pea harvest. Buck-

wheat, alfalfa, fodder corn, late potatoes, or late cabbage may be used in sections farther north. Late peas are generally followed by winter wheat. Some canners grow string beans after peas with fair success, but unless the fall frosts are unusually delayed it is doubtful whether string beans will have a sufficient period in which to mature.

INFLUENCE ON SUCCEEDING CROPS.

The growing of peas exerts a beneficial effect on many crops which may follow. The disking of the pea stubble puts the soil in excellent physical condition. The growth and seeding of weeds are partly prevented by the early working of the ground, by the heavy cover formed by the pea vines, and also by the early harvesting of the crop. The growing of peas increases the nitrogen content of the soil through the action of the nitrogen-gathering bacteria when these are present in the root nodules. Some farmers have deliberately planted peas in a belated season or have turned under a poor crop of peas without harvesting, in order to get back the value of the seed and of their labor from the increase in the succeeding crop.

Considerable attention has been given to this secondary effect. A marked increase in the yield is characteristic where grain follows peas. The increase with wheat has been noted in New York State as varying from 5 to 18 bushels per acre. Some farmers contend that the good influence of pea culture extends farther, so that a marked improvement is seen on the hay crop and on the pasturage which follows the wheat. The advantage of wheat over oats for the succeeding crop is that the land can be fitted for wheat simply by disking, whereas for oats the land must be plowed. In some sections it is considered easier to secure a stand of clover on land on which a crop of peas has been grown.

SOILS.

Peas succeed on a variety of soils provided they are well drained, but not so porous as to lose moisture rapidly. Clay loams are ideal if well supplied with humus and lime, but the maturing of the crop is generally retarded in stiff clays. Light, gravelly soils may give a moderate yield, producing a small vine growth, with an abundance of small pods. However, the crop may mature too quickly. Unless there is a retentive subsoil the plants are likely to suffer from drought if there is much sand in the soil. On the other hand, sandy soils permit early working in the spring and respond readily to fertilizers. Muck soils produce a growth of vines that is too luxuriant and give a rather limited production of pods.

The land should be uniform in slope, drainage, and fertility, so that the whole crop will reach perfection at one time. Sandy or gravelly spots ripen before wet-clay areas, and the more exposed

and better drained sections will mature before the low spots in the field. The higher and more sloping gravelly soils are less adapted to pea growing. Southern exposures are seldom selected, because such sites tend to hasten the maturity of the crop.

The pea plant reaches its best development on rich, mellow soils of a nonacid character which are well drained but retentive of moisture. A sandy loam seems best for all early varieties, but a loam or a silty loam gives the best results with the late varieties.

Humus is usually lacking in those soils which have been subjected to intensive farming for a number of years. Peas need organic matter. This material should have been incorporated in the soil with the preceding crop. Ample dressings of manure or the plowing under of a sod crop will not only supply plant food but will provide humus which will keep the soil open and mellow and assist in conserving moisture. Second-growth clover as well as the vetches and rye is a crop used for this purpose. *Pea-vine wastes should never be placed on land to be devoted to pea culture.*

Peas need an abundance of moisture and do best in those regions where the rainfall is well distributed throughout the growing season, with an annual average of between 30 and 40 inches. Through the use of a long taproot system the pea plant in some soils can take its moisture at a depth of 4 to 6 feet. This indicates that the soil should be well supplied with moisture and that a perfect seed bed be formed, because cultivation, in the ordinary sense of a moisture conserver, is not usually performed. Next to drainage, moisture is one of the important controlling factors in successful pea production.

Drainage is one of the main points in successful pea culture, for it removes the free water which would be harmful to the young pea plants if left to stagnate in the surface soil or the subsoil. The removal of the surplus water permits the free circulation of air and serves to dry the land early in the spring, allowing the early working of the soil. Drainage indirectly warms the soil and makes it possible to sow peas at an earlier date. Drainage improves the physical character of the soil and imparts to it the power to hold that moisture needed for the later growth of the pea plant. It deepens the penetration of the roots by lowering the water table, making the plants less likely to suffer from drought. In the comparison of the yield of peas on drained and undrained land, an increase of as much as 10 bushels of shelled peas per acre has been noted where artificial drainage had been provided.

PREPARATION OF THE LAND.

The preparation of the land and of the seed bed are very important and should receive the closest attention, as a fertile, deeply prepared,

mellow soil is one of the essentials in successful pea culture. The pea is a vigorous, free-growing plant, the roots of which are extensive and penetrate deeply into the ground. The crop usually receives no cultural attention after the seed is sown. The operations before planting will influence, in part, the water content of the soil for the season of pea growing. The preliminary preparation, furthermore, will control the development of the root system and influence the extent of weed infestation.

The several methods followed in the preparation of the land have arisen from the varied requirements of soils which differ widely in their physical nature. The planting of peas on heavy soil is frequently delayed in the spring by inability to prepare the land at that period. The fall plowing of all stiff soils and sod land permits the early preparation of the ground in the spring and provides a better seasonal distribution of farm labor. The exposure of these lands to the effects of alternate freezing and thawing during the winter improves the physical condition of the soil, assists in the more rapid decay of vegetable matter, and destroys insect eggs and larvæ. Fall plowing is advisable in all cases where the washing of the soil is not likely to occur. With the lighter soils, such as sandy or gravelly loams, spring plowing may be better, especially when the soils are well drained. The depth of plowing will depend upon the nature of the soil and the previous cropping system. It is good farm practice to increase the depth of plowing by half an inch each season until a soil 8 or 10 inches deep has been secured. All soils should be prepared early and portions for late sowing maintained in condition until planting time. In fitting the land the top layer should be thoroughly fined to a depth of at least 4 inches. The methods employed in preparing the soil are determined by the character of the land and the equipment available. When successive plantings are to be made the prepared land should be harrowed frequently to keep down the weeds and to maintain a perfect soil mulch. Sometimes the land is rolled just before the sowing of the seed. Pea growers find it necessary to give special attention to the preparation of the soil to maintain a smooth surface. This is necessary, as minor elevations and depressions will interfere with the use of a mower in harvesting the peas.

FERTILIZERS AND MANURES.

The judicious use of fertilizers in connection with good cultural practices will usually be a distinct aid in securing a good crop of peas. In many sections where canning peas are grown it has not been the practice to use commercial fertilizers, the growers preferring to depend on natural soil fertility and the use of stable manure. Owing

to their nitrogen-gathering properties peas may add to the supply of this element in the soil. In nearly all localities, however, light applications of nitrogen are beneficial, as the pea plant needs readily available plant food that it can use during its short growing period.

The quantity of commercial fertilizer which can be profitably used on the pea crop is dependent upon the needs of the soil, the price received for the crop, and the probable increase in yield as determined from the experience of other growers. In the absence of such evidence it would be a wise procedure for the grower to make experimental treatments on a portion of his pea field and plan next year's applications accordingly. The experience of good growers indicates that the use of a fertilizer containing 1 to 2 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 3 to 6 per cent potash applied at the rate of 300 to 600 pounds per acre will be satisfactory. On soils particularly deficient in any one element mixtures containing a higher percentage of that element should be used.

The fertilizers may be distributed broadcast by hand or with a lime spreader and then harrowed into the soil. They are, however, usually applied with a fertilizer drill. They may be applied at the time the seed is being sown, but many growers believe that fertilizers should not be run through the delivery tubes of the drill, thus coming in contact with the seed. A safe procedure would be to drill the fertilizer at one time and the pea seed at another or in separate drills working at the same time.

Stable manure when available may be applied with advantage to peas. Many growers prefer to apply the manure to the previous crop rather than to the peas themselves. Manure mixed with decayed pea vines should not be applied to land used for the growing of peas.

In case the soil is sour, an application of lime may be necessary to bring it back into proper condition. The quantity of lime varies with the condition of the soil; an initial application as large as 4 tons per acre may be profitable. When the soil is in good condition an application of half a ton is often found of advantage, especially if inoculation is to be employed. Those soils which are very rich in organic matter need larger applications of lime than sandy soils. Some growers apply lime every few years, selecting a definite place in the crop rotation. It may be spread on the soil prepared for corn or peas and worked in by further soil preparation.

INOCULATION.

The pea has the same characteristic as other leguminous plants, that of gathering nitrogen from the air and storing it up in nodules on the roots. This can take place only when certain bacteria are present. When absent the soil can be inoculated by either of two

methods: First, the transfer of surface soil from fields where the pea nodules are known to be present. This entails the handling of large quantities of earth and moreover can not be recommended for the pea, because of the risk of carrying with it the organisms which cause certain pea diseases. The second method is the direct application of pure cultures of bacteria to the seed.

Inoculation often gives an increase of 100 to 700 pounds of peas per acre. Competent authorities estimate that a dollar spent for inoculating material often gives returns varying from $15 to $20 per acre. Two organizations in Illinois obtained an average increase of 700 pounds of peas per acre as the result of pea inoculation on two large tracts where inoculation was needed. It would seem to be a good farm investment, often affording an opportunity of securing larger yields at a small expense.

Not all soils will show marked results. Those soils which are already inoculated with the pea-nodule bacteria will not show any material increase when the seed is inoculated before planting. These organisms may remain in the soil for several years. The soil may also be lacking in some important properties which even the nitrogen bacteria may not supply for the growing of peas. Well-drained soils, the lime requirement of which has been satisfied, respond more readily to inoculation than do soils not so treated.

It would be a good plan to inoculate where peas are not doing well or when there is some doubt as to the presence of the proper bacteria. To ascertain the value of such an operation, leave a check or untreated strip beside the inoculated area, and determine by actual weights of each strip the difference due to the application. Furthermore, examine the root systems and note whether there is a corresponding increase in the quantity of root nodules. Where conditions are right there will be a marked difference between the treated and the untreated areas.

SEED.

Peas used for canning purposes can be divided into two general classes, the round smooth-seed type and the wrinkled type. The smooth seeded is best for the early crop, because the peas are not so likely to rot if the soil is cold and there is heavy rainfall before the plants appear above the ground. The wrinkled peas are often referred to as "sweets," and these constitute much of the late canning crop. The advantages in the growing of early peas are the extension of the canning season, less farm labor at the time of the preparation of the soil and planting, a smaller quantity of vines to be handled, and less interference with other farm operations, such as haying, during the harvesting of the peas.

Some varieties commend themselves to the canners because the largest possible proportion of the pods are in prime edible condition at one time. This is an important factor in pea culture, where the vines are cut with a mower and the whole crop is taken to the viner. Among the several varieties of early peas those most extensively grown for canning purposes are the Alaska, Surprise, and Little Gem. Among the late sorts are Horsford's Market Garden, Admiral, Advancer, and Perfection. Efforts are being made by various agencies to develop and improve varieties for canning purposes.

Seed should be procured from a reliable source. The stock seed from which the commercial supply is grown should be carefully rogued. It is not wise, however, for the canner to demand commercial seed which has been rogued, since this operation is very expensive when properly done. Moreover, if the stock seed is well guarded, there will be no necessity to rogue the commercial seed. The seed should all be of the crop of the previous year and not a blending of peas of different ages. It is best to make a germinating test of the purchased seed early in the spring to determine the proper quantity to sow. It is to the canner's best interest to provide the best quality as well as the best varieties of pea seed. Both the canner and the grower should guard against the mixing of early and late varieties.

SEEDING.

The time of planting is dependent upon the locality, the weather, the soil conditions, and the variety to be grown. While peas are not injured by moderate frosts, they are damaged by a hard freeze. Most growers prefer to delay the seeding of the early varieties until there is little probability of a frost after the plants have attained a height of several inches. Most growers make successive plantings, allowing a lapse of several days between seedings, so that the entire crop will not be ready for harvest at one time. The canning agent usually specifies that the grower shall sow on one day only that acreage which normally he can harvest in the same period.

The best growers use either a grain drill or a special pea seeder for planting the crop. The use of this type of equipment gives better results than can be had by sowing the seed broadcast and harrowing or plowing it in, as the seed is all placed at a uniform depth and is uniformly distributed. Attention should be given to prevent any overlapping of the seeding, while some space should be left between two varieties when they are planted in the same field. Sometimes the land is rolled after the seed is sown.

The quantity of seed to be sown per acre will vary with the variety used, the quality of the seed, the character of the soil, the preparation of the seed bed, and other factors. Standard quantities are 3½ to 4½

bushels per acre of Alaska and 4 to 4½ bushels of Horsford's Market Garden. Some growers have received larger yields through heavier rates of seeding, the profitable limits of which must be determined by the grower. The quantity of seed should be sufficient to prevent the growth of weeds and grass, but not so heavy that the plants will crowd each other. A good depth is 3 to 4 inches, giving, perhaps, the highest percentage of germination and the greatest yield. The depth is partially governed by the character of the land, light soils requiring deeper seeding to prevent excessive drying out. The earlier plantings should be shallower than those made later. The time of maturity is not materially affected by the depth of planting.

The land is rolled or planked immediately after the seed is sown. This compacts the seed bed and makes a smooth surface upon which to operate the mower at harvest time. Just before the peas begin to break through the soil it may be advisable to run a 5-toothed weeder over the land in the same direction as the drill. This is done when the land appears weedy or when the soil has a tendency to bake.

The pea, like some cereals, is not usually cultivated. The crop starts quickly and makes rapid growth, usually preventing most weed competition. In newly acquired or poorly managed land in some sections of the country the annual wild mustard may so completely infest the land that the pea crop will be seriously injured. This weed can be destroyed when but a few inches high by spraying with a solution of 12 pounds of copper sulphate in 50 gallons of water. The young mustard plants are more easily destroyed than those approaching the blooming period, and the spraying is most effective when done on a bright, hot day. If the Canada thistle is prevalent it is advisable to go through the fields and cut the buds and blossoms just before the harvesting of the peas. These parts then dry up and fall to the ground. If not cut, they will thrash out with the peas and, being of the same size and weight, will pass through the factory machinery and get into the cans with the shelled peas. While cutting the thistle, one can pull the larger weeds, like milkweed, without damaging the pea crop.

HARVESTING.

The period between the date of planting and the time of harvesting varies from 6 to 12 weeks, depending upon the soil, weather conditions, and the variety grown. In the Northern States the season of harvesting is prolonged by resorting to the use of successive plantings of the same variety, as well as by the sowing of early and late varieties. In the more southern States the whole crop is liable to mature at about the same time without regard to the time of planting. This naturally restricts the area to be planted in such sections, be-

cause of the limited farm equipment and the danger of overcrowding the factories.

The time for harvesting is determined largely by the appearance of the pods. These should be swollen and well filled with young succulent peas and changing in color from dark to light green. By this time the vines have attained their full growth, and the stem, which retains all of its leaves, is still succulent. It is the aim to harvest the peas at a time when the maximum yield will be secured, but while the peas are still in prime condition.

As the peas approach the time of harvest the fields should be carefully watched to see that the crop does not pass prime canning con-

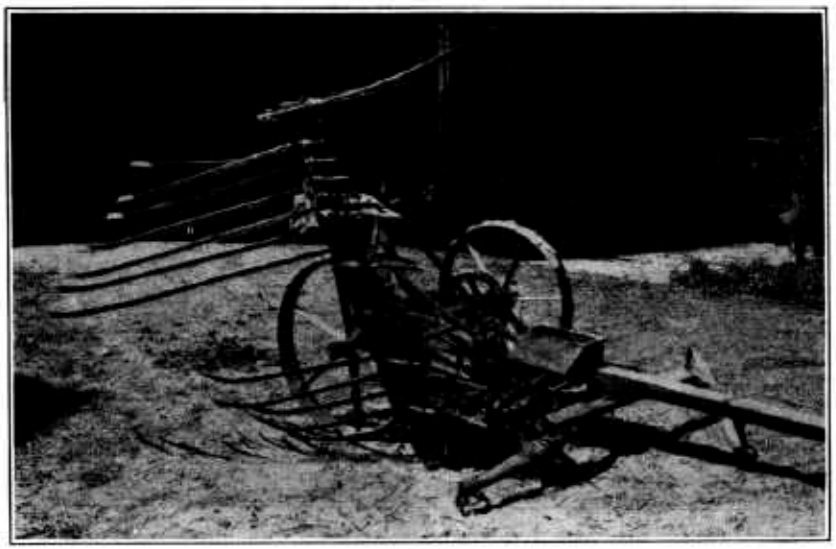

FIG. 3.—A mowing machine fitted with lifting guards and a swather or windrowing device, as used for cutting peas.

dition. This inspection should embrace all parts of the field, since some spots may ripen before others, owing to soil and other differences. Sometimes it is necessary to cut one portion of a field before the rest. This thorough examination is especially necessary during wet seasons to guard against the development of a second growth of the peas. If the weather continues moist when the crop has nearly reached maturity the pea vines will begin to lodge. These plants will then send out new shoots, which grow upward and begin to flower. The main crop may be fully mature, while the upper portions of the vines are in blossom. If the harvesting is delayed it may mean the loss of the main crop in favor of the second growth, the yield of which would be negligible. The exact day of harvest is determined by an agent of the cannery, who directs that the peas be cut and delivered to the factory. This demands the closest coopera-

tion between the grower and the canner, in order that the peas may be harvested and hauled to the factory only as fast as they can be used.

In the best practice an ordinary mowing machine, fitted with special vine-lifting guards and swather (fig. 3), is usually used to cut the crop. These guards are big-fingered attachments which are placed on the cutter bar of the machine; they lift the vines off the ground so that the crop is cut off close to the soil. After the vines are cut they are rolled by the swather, or bunching device, and are dropped at the rear (fig. 4), leaving the pea vines in a neat windrow in the middle of the swath. When using the ordinary mower it is necessary to fork over the material from each swath as it is cut,

FIG. 4.—Cutting peas with a mowing machine fitted with lifting guards and a windrowing device.

in order that the pea pods may not be broken by the hoofs of the horses or by the wheels of the mower on the next round. When the vines are very heavy it is sometimes necessary that a man with a hay fork follow the mower and assist in removing the matted mass. The vines should be handled as little as possible after cutting.

The vines are usually mowed early in the morning or late in the afternoon, especially when the weather is very warm. Only that quantity which can be hauled quickly should be cut at one time. The sun and high temperatures cause the vines to wilt when lying on the ground or to heat when bunched in piles and during transportation. Heating is more likely to occur when the peas contain large quantities of weeds.

Peas may be loaded directly to wagons (see the title-page illustration) from the swath, or they may be raked with a side-delivery rake (fig. 5) and loaded from the windrow. The latter method

saves labor, but the additional handling may be somewhat injurious to the peas. The vines are immediately hauled to the canning factory or to a field vining station. They are usually loaded by hand on a wagon provided with hayracks, but occasionally a hay loader can be used. The wagons should not be loaded until the grower is sure that he will be able to haul them directly to the viner. Auto trucks, which are better than wagons for long hauls, are coming into use where road conditions permit.

In order to avoid the hauling of large quantities of vines over long distances to the cannery, the plan of establishing vining stations has been adopted in many sections. This enlargement of facilities en-

FIG. 5.—A side delivery rake in use in a pea field.

ables the canning companies greatly to extend their sphere of operations, for it is possible with the aid of trucks to haul the shelled peas for several miles to the cannery. These vining stations consist of one or more viners installed in a simple type of building and operated by a portable engine (fig. 6). One of these stations usually handles the pea crop of several farms.

Whether delivered to the main factory or to a field viner the peas should be vined immediately. When it is impossible to handle a load or two late in the day, the vines should be kept spread out in thin layers to prevent heating. The use of the field vining stations demands the rapid handling and transportation of the shelled product. The podded peas should be placed in layers about 4 inches deep in tray boxes, and to insure proper ventilation the bottoms of these trays

should be made of fine-mesh wire. After shelling, the peas should not be allowed to stand over night but should be canned as soon as possible. The whole process of harvesting and handling the pea crop requires the utmost dispatch if a good canned product is to be prepared.

The labor required in harvesting peas depends upon the available equipment. Under ordinary conditions the area of peas to be cut in any one day should be restricted to the quantity which can be hauled by the available labor and equipment.

YIELDS, COSTS, AND PAYMENT.

The yield of peas to the acre varies with the variety and the conditions under which the crop is grown. It may range from a crop

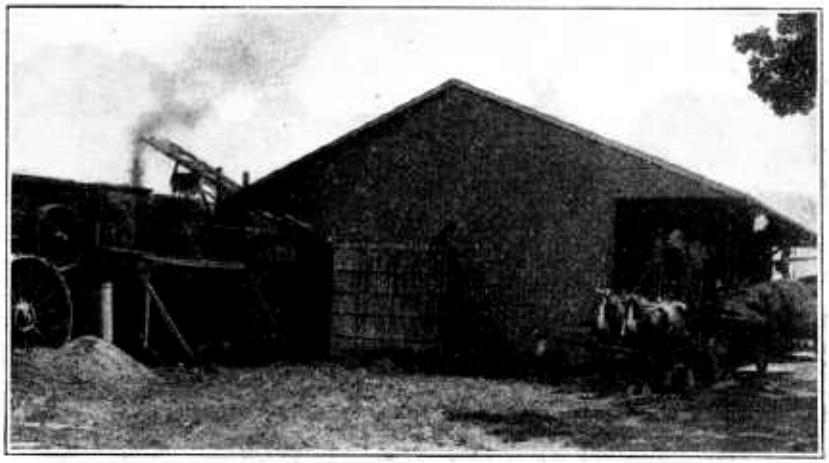

FIG. 6.—Vining station used to shell peas grown at a distance from the cannery. This procedure makes it unnecessary to haul a heavy tonnage of vines long distances.

failure to more than 2½ tons of shelled peas. The average yield in the United States each year of a 4-year period was 1,600 pounds, 2,000 pounds, 1,600 pounds, and 2,000 pounds of shelled peas per acre for the years 1917, 1918, 1919, and 1920, respectively.

As a general rule, the yield of the smooth or early varieties of peas is smaller than that of the wrinkled or late varieties. From figures gathered during the past several years in the States of New York and Wisconsin, it has been found that the yields of the early varieties range from 860 pounds to 2,400 pounds per acre, and of the late varieties from 1,000 pounds to 3,250 pounds per acre.

The profits per acre are dependent upon the yield per acre and the prices paid by the canning firms. These profits may vary from a poor crop, where the cost of seed, labor, etc., are scarcely met, up to $100 per acre. The cost of growing peas depends upon the rental of the land, the character of the soil, the cost of the labor, seed, and

fertilizer, the sowing of peas, and other items. These should not differ greatly from the cost of an ordinary grain crop. It does, however, cost more to harvest the crop, owing to its great bulk of vines. The cost of hauling is an additional factor to be considered. As these factors vary in the different sections of the country, no definite figures can be given.

The basis upon which payment for the crop is made varies in different sections and with different canners. Some canners pay a flat rate per bushel or per 100 pounds of shelled peas. A second method is to pay graduated prices, as gauged by an inspection of each load of peas. The third system is to pay one of several prices, according to the percentage of peas of different sizes and of different quality, as indicated in a sample from each load of peas. The principle of this test is that small size is associated with immaturity and tenderness. The fourth scheme is based on a sample of peas taken from the vines and its division into the five customary factory sizes. Payment is made on the percentage basis of each size or combination of sizes. The fifth plan considers the effect of gravity on a sample of shelled peas in a series of brine solutions. This test separates the peas on the basis of quality rather than size.

In the first instance, the canner insists that the peas be delivered as young as it is possible to use them. The farmer, however, finds it to his advantage to delay delivery to obtain an increase in growth and weight of the product. It affords no extra returns for a superior crop. The ratings in the second method are a matter of judgment on the part of the inspector. The third system provides payment according to the one grade of size and quality which may be assigned from the examination of the load. The fourth scheme is more accurate, since payment is made on the mechanical grading of the crop, the smallest peas receiving the highest premium. The fifth plan considers quality as the basis upon which to make payment. The ideal system for the grower and for the canner could well be a combination of those methods which place emphasis on size, weight, and quality.

Peas for canning to meet standard requirements as to size[1] must be small enough to pass before blanching through screens with meshes as follows: No. 1, nine thirty-seconds of an inch; No. 2, ten thirty-seconds of an inch; No. 3, eleven thirty-seconds of an inch; No. 4, twelve thirty-seconds of an inch; No. 5, thirteen thirty-seconds of an inch; No. 6, above thirteen thirty-seconds of an inch. The return of the vines as hay or as silage may also enter into the question of fixing prices for peas.

[1] United States Department of Agriculture, Office of the Secretary. Standards of purity for food products. U. S. Dept. Agr., Office Sec., Cir. 136, p. 9. 1919.

INSECT PESTS.[2]

The pea crop is subject to the injurious attacks of certain insect pests. Among the insects which may cause damage are the pea aphis[3] and the pea weevil.[4] The aphis is perhaps the only insect which makes serious inroads on the growing of green peas. The aphis can be controlled in part by the observance of those measures mentioned under rotations and by the use of natural enemies. The presence of the weevil should be noted, so that proper allowance may be made at the time of planting for infested seed. Weevil-infested seed may give a germination as low as 30 per cent. The pea moth which feeds within the pods on the ripening peas has made its appearance in northeastern Wisconsin and is reported from Michigan. It is a serious pest in Canada.

PEA DISEASES.[5]

The pea plant is subject to two groups of plant diseases, both of which vary in prevalence in different localities from season to season. The more conspicuous and better known group consists of those which attack parts of the plant above ground. Among these are the so-called pea blight, leaf and pod spot, and mildew. The less conspicuous and more important group of diseases cause decay of the plant below ground, resulting in reduced growth and in extreme cases the wilting of the entire plant. Against both these groups of diseases only preventive measures are practicable.

CLEAN SEED.

One of the more important foliage diseases, commonly called blight, is known to be carried with the seed, and wherever this disease has been found to develop abundantly care should be taken to obtain seed from clean fields. The spread of blight in seed, however, is probably not as general or extensive as has been believed.

CROP ROTATION.

All or nearly all of the foliage diseases are carried over from year to year on dead straw and débris of the pea plant. Whenever these diseases become troublesome they can readily be controlled by crop rotation. The diseases which cause decay of the plant below ground at the base of the stem or on the root may also be controlled by crop rotation, though not as readily, since the fungi causing this injury

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[2] Information in regard to the methods to be employed for the control of the pea aphis, the pea moth, and the pea weevil will be furnished upon application to the Bureau of Entomology, U. S. Department of Agriculture.

[3] Davis, J. J. The pea aphis with relation to forage crops. U. S. Dept. Agr. Bul. 276, 67 p., 17 fig. 1915. Bibliography, p. 55–67.

Chittenden, F. H. The pea aphis. U. S. Dept. Agr., Bur. Ent. Cir. 43, 2d ed. 10 p., 7 fig. 1909.

[4] Back, E. A., and Duckett, A. B. Bean and pea weevils. U. S. Dept. Agr., Farmers' Bul. 983, 24 p., 24 fig. 1918.

[5] Prepared by F. R. Jones, Bureau of Plant Industry.

are soil-inhabiting organisms which persist a long time when once they have become abundant. They are not known to be carried with the seed. In the newer sections peas are often grown several years before any of the root diseases develop to such an extent that there is any conspicuous decrease in the yield of the crop, but when the disease has become thoroughly established and there is any opportunity whereby it may be distributed over adjoining fields by wind-blown dust or drainage water these fields very quickly become unprofitable for pea culture. Growers, therefore, should study conditions in their own sections and watch very carefully for any appearance of root disease, in order to avoid planting peas in any fields in which it has developed. Although no hard and fast rule can be laid down, it is usually recommended that a rotation be practiced which places peas upon a field not oftener than once in four years, provided that no form of root rot is known in that field. After the disease has once appeared, a longer rotation is usually required to reduce the trouble to such an extent that a profitable crop is assured. It is particularly important that soil for inoculation purposes should never be taken from an old pea field where any root trouble has occurred, as in this manner the parasites are readily transferred to new soil.

VINE DISPOSAL.

Large quantities of vines remain after the peas are thrashed. Formerly this material was considered worthless and a nuisance. The canners paid the farmers to haul it away for manure, or it was left in piles to decompose. The dumping of pea vines in large quantities soon led to the discovery that a large percentage of the vines thus handled was preserved like silage and greedily eaten by live stock. These vines are now considered a valuable by-product, but in some regions this material is being wasted because its feeding and manurial value is not fully appreciated.

Freshly gathered vines may be used in their natural state as green feed, and as such they are probably equal to any other soiling crop. Because of the bulky nature of this material, it must be used near the cannery or vining station.

Curing the vines for hay may be practiced under favorable conditions. However, the labor involved in spreading and turning the vines in curing makes it an expensive way of handling the material. Some farmers take their quota of vines from the factory and spread them on sod land to cure, or, if the vines are to be hauled some distance, they may be dried on some vacant lot near the factory. Some canning establishments cure all the refuse material and then sell it at about the cost of the operation. As soon as it is thoroughly dry the hay is baled, stacked, or stored in a mow. If this material

is well cured, it is relished by horses, cattle, and sheep, and when not allowed to become injured in curing this roughage is said to approach clover hay in nutritive quality and palatability.

There are two general methods of making silage, either by constructing stacks or by using silos. When a limited quantity is to be handled by one person—from 50 to 75 tons—the silo will prove most satisfactory, although some canneries have one or a battery of silos, each holding up to 200 tons (fig. 7). Silos for the individual grower are common in dairy sections.

Pea vines may be stacked according to the methods used in putting up hay, straw, etc. The stacks themselves may be of any size and

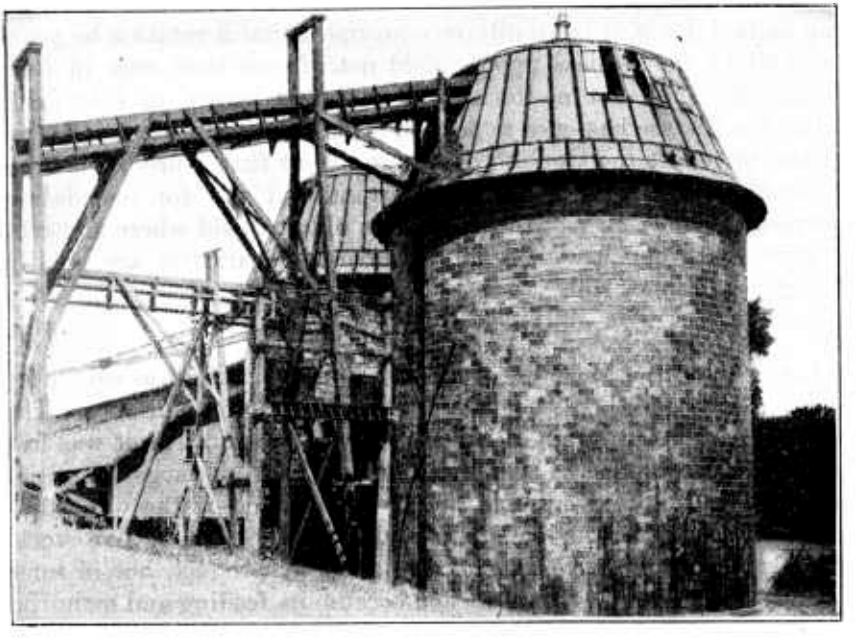

FIG. 7.—Silos used for the preservation of pea vines.

are frequently 80 feet long, 20 feet wide, and as high as it is convenient to build them (fig. 8). Many viners are equipped with carriers which permit the building of stacks 20 to 25 feet high. Owing to the large moisture content of the pea vines, a considerable quantity of juice exudes from the bottom of the stack or silo. Suitable drainage should be provided to carry off the surplus juices. The larger the pile and the better compacted, the smaller will be the proportion of spoiled material. Under normal conditions only the outer 8 to 12 inches should decompose. This spoilage, when well rotted, can be used as manure after it is thoroughly decomposed.

When a silo is used the vines are placed therein just as they come from the viner, or this material may be shredded through a silage

cutter. The pods and vines are usually run into the silo by the use of a conveyor. As a rule well-trampled pea silage will not shrink perceptibly, and only a limited quantity will spoil. Pea vines kept in silos can be removed and used with a minimum of waste. Although the cost and maintenance of the silo amount to a considerable sum, the value of the vines saved will soon pay for the investment.

The manner of the disposal of the green-pea vines, the pea hay, and the silage varies. Some canners offer these materials free, to induce the farmers to grow peas. In some cases, the farmer is allowed the weight of green vines brought to the factory, less the quantity of peas thrashed, or it may be prorated on the basis of shelled peas sowed or produced. At other factories the canners reserve the

FIG. 8.—A partly completed stack of pea vines located at a vining station.

material for their own feeding. Sometimes a farmer or a stock-feeding concern may contract for all the refuse. In cases where the factory makes silage, this silage supply may be prorated among the farmers who produce the original material. It may sometimes be sold back to the producers, and any excess to nonproducers, to whom, however, a higher price is charged. The making of silage by the factory may be an advantage to the producer, since he can haul the material in the slack winter season.

The yield of vines varies with the variety, the soil, and the seasonal conditions, the average from an acre of peas approaching 3 tons, although there may be yields as high as 10 tons. On the market, silage made from these vines varies in price from year to year, as do all feeding materials. The value of pea vines as a food for live stock is sufficiently great to warrant the expenditure incurred in providing

facilities for handling and storing the vines by such methods as will result in reducing the waste to a minimum.

FEEDING.

The growing of canning peas in a dairy or a live-stock section is in many instances a valuable procedure, producing large quantities of desirable food materials which may be used in the green state, as hay, or as silage. Pea silage is especially valuable for late summer feeding when pastures are short and before new corn silage is available. The same precautions observed in feeding corn silage should be followed in the feeding of pea silage to dairy cattle, for milk absorbs the strong odor when kept in proximity to the silage. It would seem best not to feed in too large quantities and to place the silage in the manger shortly after milking and also to see that the barn and manger are free of the material at milking time. Sometimes beef cattle are wintered on pea silage exclusively, but often it may be supplemented with sweet-corn stover and other materials produced on the farm. Canners frequently winter large herds of stock, using pea silage for the greater part of the ration, and many have found this profitable. In some communities the canneries run boarding stables for cattle buyers during the winter months. Pea-vine silage has become highly regarded in Wisconsin and New York as a winter feed for sheep. The hay has been used as roughage for work horses and mules during the winter months.

MANURE.

The pea as a cover crop returns a large quantity of green matter to the soil. In cases where it is not profitable to harvest the pea crop for canning, as after a destructive infestation of aphis, the vines may be turned under, adding materially to the plant food and humus in the soil. The outer layer from the stack is often used as an orchard mulch. Orchardists realize that this pea-vine waste is an excellent humus carrier, and in some localities there is great demand for this material. In other cases the lower layer soaks up the liquids which drain from the stack. This material must be allowed to decompose, for if used while fermenting this refuse may cause serious injury to the crop to which it is applied. Furthermore, pea wastes should not be used as a manuring crop on those lands which are intended for pea culture in less than five years.

When the pea vines are completely rotted, they have a fair fertilizing value; but it will perhaps be found to be even better if the roughage is first fed to stock, as only a small portion of the fertilizing constituents need be lost in animal feeding. The manure can then be applied to crops and a double return obtained.

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